

CONFIDENTIAL

CLASSIFICATION CONFIDENTIAL

CENTRAL INTELLIGENCE AGENCY
INFORMATION FROM
FOREIGN DOCUMENTS OR RADIO BROADCASTS

REPORT

50X1-HUM

CD NO.

COUNTRY USSR

DATE OF
INFORMATION 1949SUBJECT Scientific - Chemicals, electrochemical
industry

DATE DIST. // JAN 1951

HOW
PUBLISHED BookWHERE
PUBLISHED Moscow/Leningrad

NO. OF PAGES 7

DATE
PUBLISHED 1949SUPPLEMENT TO
REPORT NO.

LANGUAGE Russian

THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE
OF THE UNITED STATES WITHIN THE MEANING OF ESPIONAGE ACT 50
U. S. C. 31 AND 32, AS AMENDED. ITS DISSEMINATION OR THE REVELATION
OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PRO-
HIBITED BY LAW. REPRODUCTION OF THIS FORM IS PROHIBITED.

THIS IS UNEVALUATED INFORMATION

SOURCE

Tekhnologiya Elektrokhimicheskikh Proizvodstv, Goskhimizdat, 1949, 676 pp,

50X1-HUM

INFORMATION FROM "TECHNOLOGY OF ELECTROCHEMICAL PRODUCTION"
BY L. L. KUZ'MIN, V. G. KHOMYAKOV, AND V. P. MASHOVETS

The book presents a general course on the technology of electrochemical production. Part I describes the technology of the chemical sources of electric energy, such as galvanic cells and lead and alkaline storage batteries. Part II deals with electrokinetic processes, the technology of electrolytic processes for production of hydrogen and oxygen and chlorine and alkalis, as well as products of oxidation and reduction processes. Part III analyzes problems in electrometallurgy and electrolytic metal plating.

The book, authorized for use as a textbook for students in chemical and technological higher educational institutions, may also prove useful to students in metallurgical higher educational institutions and to engineers in the electrochemical industry. Five thousand copies of this edition have been published.

Excerpts from the introduction and the table of contents follow.

EXCERPTS FROM INTRODUCTION

In 1913, the total power capacity of all Russian electric power stations was 1,098,000 kw, i.e., Russia was one of the most backward countries as far as electric power production is concerned. Under the circumstances, it is not surprising that the electrochemical industry was in a rudimentary state, notwithstanding the fact that many inventions and discoveries in the field of electrochemistry had originated in Russia.

This situation changed after the October Revolution, as a consequence of the launching of the plan for the electrification of Russia.

- 1 -

CLASSIFICATION		CONFIDENTIAL		CONFIDENTIAL	
STATE	<input checked="" type="checkbox"/> NAVY	<input checked="" type="checkbox"/> NSRB	DISTRIBUTION		
ARMY	<input checked="" type="checkbox"/> AIR	<input checked="" type="checkbox"/> FBI	all <input checked="" type="checkbox"/>		

CONFIDENTIALCONFIDENTIAL

50X1-HUM

At the beginning of 1941, the capacity of USSR electric power stations was 11 times higher than before the revolution, and the production of electric energy was 25 times higher. This means that with respect to electric power production, the USSR occupied the second place in Europe and the third in the world.

Thus, during the period of the first three Stalin Five-Year Plans, the prerequisites for the development of a powerful and modern electrochemical industry were created in the USSR. During the period in question, a number of new electrochemical industries came into being. These include the production of aluminum, magnesium, sodium, and zinc; the refining of lead and nickel; and the production of hydrogen and peroxides. The industries which had already existed in prerevolutionary Russia (copper refining, chlorine production, and the production of lead storage batteries) were considerably expanded. Some of these industries are now the largest in the world.

The law in regard to the Five-Year Plan provides the following increases during 1946 - 1950; doubling aluminum production and increasing the production of magnesium by a factor of 2.7, nickel by a factor of 1.9, zinc by a factor of 2.5, copper by a factor of 1.6, and increasing caustic soda production by 278,000 tons. Furthermore, the current Five-Year Plan specifies an increase in the capacity of electric power stations of 11.7 million kw, thus bringing the total capacity of USSR electric power stations up to 22 million kw.

TABLE OF CONTENTS

	<u>Page</u>
Preface	8
Introduction	9
PART I. CHEMICAL SOURCES OF ELECTRIC ENERGY	
I. Galvanic Cells	16
A. General Theory of Galvanic Cells	16
1. Electromotive Force of Galvanic Cells	16
2. Thermodynamics of Galvanic Cells	20
3. Polarization and Depolarization of Galvanic Cells	26
4. Electrical Characteristics of Galvanic Cells	31
B. Cells With a Liquid Electrolyte	36
1. Cells Without Depolarizers	36
2. Cells With Liquid Depolarizers	39
3. Cells With Solid Depolarizers	41
4. Cells With Gaseous Depolarizers	47
5. The Problem of Making a Combustion Cell	50
C. Dry Cells	53
1. Design and Theory of Dry Cells	53
2. Manufacturing Electrodes for Dry Cells	61
3. Preparing Electrolyte and Assembly of Dry Cells	74

- 2 -

CONFIDENTIAL**CONFIDENTIAL**

CONFIDENTIAL
CONFIDENTIAL

50X1-HUM

	<u>Page</u>
II. Lead Storage Batteries	81
A. Theory of Lead Storage Batteries	81
1. Fundamental Data on Lead Storage Batteries	81
2. Theory of Double Sulfonation	83
3. Anode and Cathode Potentials	84
4. Thermodynamics of Lead Storage Batteries	87
B. Electric Characteristics of Lead Storage Batteries	89
1. Charging and Discharge Curves	89
2. Capacity of Lead Storage Batteries	94
3. Efficiency and Spontaneous Discharging	103
C. Design and Manufacture of Lead Cell Plates	103
1. Design of Plates	103
2. Design of Grids and Plates	111
D. Technology of Lead Storage Battery Manufacture	118
1. Filling Plate With Paste	118
2. Forming Plate	127
3. Assembly of Storage Batteries	132
III. Alkaline Storage Batteries	140
A. Theory and Electric Characteristics of Alkaline Storage Batteries	140
1. Reactions Taking Place in Alkaline Storage Batteries	140
2. Electrode Potentials and EMF of Alkaline Storage Batteries	145
3. Electric Characteristics of Alkaline Storage Batteries	146
B. Manufacture of Alkaline Storage Batteries	151
1. Electrodes for Iron-Nickel Storage Batteries	151
2. Electrodes for Cadmium-Nickel Storage Batteries	156
3. Assembly of Alkaline Storage Batteries	158
4. Advantages, Disadvantages, and Practical Application of Alkaline Storage Batteries	161
Bibliography for Part I	164
Part II. ELECTROCHEMICAL PRODUCTION PROCESSES WITHOUT SEPARATION OF METALS	
IV. Electrokinetic Processes	165
A. Electroosmosis and Electrophoresis	165
1. Electrokinetic Potential	166
2. Rate of Electroosmosis and Electrophoresis	168
3. Technical Application of Electroosmosis and Electrophoresis	170

- 3 -

CONFIDENTIAL**CONFIDENTIAL**

CONFIDENTIAL
CONFIDENTIAL

50X1-HUM

	<u>Page</u>
B. Industrial Utilization of Electrokinetic Processes	170
1. Dehydration of Peat	170
2. Refining of Kaolin	172
3. Refining of Glue and Gelatin	173
4. Electrodeposition of Rubber	174
5. Tanning of Leather	175
6. Electroosmotic Purification of Water	176
V. Electrolytic Production of Hydrogen and Oxygen	184
A. Theoretical Basis of Electrolytic Production of Hydrogen and Oxygen	186
1. Properties of Hydrogen and Oxygen	186
2. Processes Taking Place on the Electrodes in Electrolysis of Water	187
3. Theoretical Voltage in Decomposition of Water	191
4. Potential Balance (in bath)	197
5. Balance of Energy and Material	201
B. Working Principles of Baths for Electrolysis of Water	205
1. Suitable Conditions for Electrolysis	205
2. Types of Electrodes	207
3. Separation and Drawing Off of Gases	211
4. Supplying Baths With Water	214
C. Industrial Baths for Electrolysis of Water	216
1. Types and Classification of Industrial Baths	216
2. Monopolar Baths With Simple Electrodes	219
3. Monopolar Baths With Complex Electrodes	224
4. Bipolar Baths	233
D. Electrolysis of Water Under Pressure	244
1. General and Theoretical Principles	244
2. Practical Application of the Electrolysis of Water Under Pressure	246
VI. Electrolytic Production of Chlorine and Alkalis	250
A. General Data on Chlorine Production	250
1. Properties and Use of Chlorine	250
2. Development of Chlorine Production	253
3. Crude Materials for the Electrolytic Production of Chlorine and Alkalis	254
B. Theoretical Principles of Electrolytic Production of Chlorine	260
1. Electrode Processes	260
2. Voltage and Energy of Dissociation of Chlorides	267
3. Electrolytic Procedures for Producing Chlorine	273
C. Electrodes and Diaphragms for Chlorine Baths	275
1. Anodes and Cathodes	275
2. Diaphragms	282

- 4 -

CONFIDENTIAL**CONFIDENTIAL**

CONFIDENTIALCONFIDENTIAL

50X1-HUM

	<u>Page</u>
D. Electrolytic Method of Producing Chlorine With a Solid Cathode	287
1. Theoretical Basis of Method With Immovable Electrolyte	287
2. Construction of Bath With Immovable Electrode	294
3. Theoretical Basis of Procedure With Counterflow	296
4. Baths With Counterflow and Separation of the Electrolyte Into Layers	304
5. Baths With Counterflow and Filtering Diaphragm	308
E. Electrolytic Method of Producing Chlorine With a Mercury Cathode	324
1. Theoretical Principles of Mercury Cathode Method	324
2. Construction of Mercury Baths	335
F. Fundamental Processes and Schematic Diagrams of Electrolytic Production of Chlorine and Alkalis	344
1. Basic Technological Processes	344
2. Schematic Diagram of Electrolytic Chlorine Production in Baths With Filtering Diaphragm	352
VII. Electrolytic Manufacture of Products of Oxidation and Reduction	355
A. Electrochemical Oxidation and Reduction	355
1. Oxidation-Reduction Processes at Electrodes	355
2. Conditions Influencing the Course of Oxidation-Reduction Processes	357
B. Electrochemical Production of Oxygen-Containing Chlorine Salts	362
1. Production of Sodium Hypochlorite	362
2. Production of Chlorates	370
3. Production of Perchlorates	379
C. Electrochemical Production of Peroxides and Other Oxidized Compounds	382
1. Production of Sodium Persulfates and Hydrogen Peroxide	382
2. Production of Sodium Perborate	393
3. Production of Potassium Ferricyanide	396
4. Production of Manganese Compounds	399
5. Recovery of Chromic Acid	404
D. Technology of Electrochemical Reduction of Production of Sodium Hyposulfite	406
Bibliography for Part II	410
PART III. TECHNOLOGY OF THE ELECTROLYTIC SEPARATION OF METALS	
VIII. Hydroelectrical Metallurgy	411
A. Theoretical Principles of Hydroelectrical Metallurgy	412
1. Cathodic Separation of Metals From Aqueous Solutions	412
2. Anodic Solution of Metals	416

- 5 -

CONFIDENTIAL**CONFIDENTIAL**

CONFIDENTIAL
CONFIDENTIAL

50X1-HUM

	<u>Page</u>
B. Electrolytic Copper Refining	424
1. General Information	424
2. Theoretical Principles of the Electrolytic Process for Refining Copper	426
3. Technology of Electrolytic Copper Refining	435
4. Processing of the Electrolyte and Sludge	448
C. Electrolytic Refining of Noble Metals	452
1. Silver Refining	452
2. Gold Refining	459
D. Electrolytic Process for Extracting Zinc and Copper From Ore	463
1. Electrolytic Production of Zinc	463
2. Electrolytic Production of Copper	478
E. Hydroelectrical Metallurgic Processes for Nickel, Lead, Tin and Iron	485
1. Electrolytic Separation of Nickel	485
2. Electrolytic Separation of Lead	493
3. Electrolytic Separation of Tin	498
4. Electrolytic Separation of Iron	501
IX. Technology of Electrolytic Metal Plating	507
A. Methods of Protecting Metals From Corrosion	507
1. General Information on Corrosion	507
2. Methods of Protecting Against Corrosion	514
B. Theoretical Principles of Electrolytic Plating	519
1. Mechanism of the Cathode Discharge of Ions	519
2. Mechanism of the Formation of Cathodic Deposits and Their Structure	523
3. Dispersion Capacity of Baths	533
4. Adhesion of Deposit to Support	538
C. Practical Metal Plating	539
1. Preparation of Object for Plating	539
2. Deposition of Copper, Silver, and Gold	544
3. Deposition of Zinc and Cadmium	550
4. Deposition of Nickel, Cobalt, and Iron	555
5. Chromium Plating	561
6. Deposition of Tin, Zinc and Alloys	566
7. Installation and Equipment of Electroplating Shops	571
8. Galvanoplasty	578
X. Electrometallurgy of Fused Materials	588
A. General Principles of the Electrometallurgy of Fused Materials	588
1. Theory of the Electrolysis in Fused Media	588
2. Specific Technological Features of Electrolysis of Fused Materials	599

- 6 -

CONFIDENTIAL**CONFIDENTIAL**

CONFIDENTIAL
CONFIDENTIAL

50X1-HUM

	<u>Page</u>
B. Electrolytic Production of Alkali Metals	602
1. Production of Sodium From Caustic Soda	603
2. Production of Sodium From Sodium Chloride	608
3. Electrolytic Production of Other Alkali Metals	611
C. Electrolytic Production of Alkaline Earth Metals	613
1. Production of Magnesium by Electrolysis of Magnesium Chloride	613
2. Other Methods of Producing Magnesium	625
3. Refining of Magnesium	627
4. Electrolytic Production of Calcium	628
5. Electrolytic Production of Beryllium	632
D. Electrolytic Production of Aluminum	635
1. General Information on Properties, Uses, and Production of Aluminum	635
2. Raw Materials for the Electrolytic Production of Aluminum	639
3. Theoretical Principles of Electrolytic Production of Aluminum	646
4. Construction of Baths	653
5. Operation of Baths	658
6. Remelting and Refining of Aluminum	663
Bibliography for Part III	666
Index	667

- E N D -

- 7 -

CONFIDENTIAL**CONFIDENTIAL**